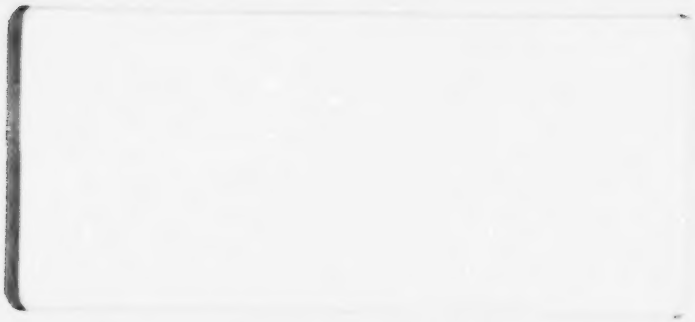

Manitoba
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Safety and Health

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CADMIUM IN KIDNEY AND LIVER
OF MANITOBA MOOSE AND ELK
1986 - 1987

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Department of Environment and Workplace Safety and Health
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Abstract

In 1986-87, Manitoba hunters voluntarily provided kidney and liver samples from 160 moose and 55 elk for cadmium analysis. This was a follow-up study from a preliminary survey undertaken in 1985 by the Manitoba Department of Environment and Workplace Safety and Health and the Manitoba Department of Natural Resources.

Cadmium concentration in moose kidney ranged from 0.3 to 42.7 mg/kg while those in moose liver ranged from 0.01 to 8.9 mg/kg. Moose taken from the west side of the province generally had higher levels of cadmium. Concentrations of cadmium were lower in elk kidney and liver, ranging from 0.8 to 39.2 mg/kg in kidney and 0.1 to 1.3 mg/kg in liver. In both moose and elk cadmium was found to accumulate with age and was not related to sex of the animal.

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1. INTRODUCTION

The Manitoba Department of Environment and Workplace Safety and Health and the Manitoba Department of Natural Resources have been cooperatively studying cadmium (Cd) levels in moose (Alces alces) since 1985. The study was initiated with a preliminary survey in 1985. This was in response to concerns raised in central Ontario where elevated cadmium levels ranging from 22 to 99.0 mg/kg were found in moose kidney in 1984.

In 1986/87, the study was expanded through additional resource support from the Wildlife Toxicology Fund, Environment Canada. The number of moose samples was increased substantially in both 1986 and 1987. As well, the study was diversified to incorporate additional wildlife species. Factors used in selecting species to be tested included individual food habits, trophic level in the environment, and the degree of consumptive use by humans. The study currently includes the following species: Elk (Cerus elaphus), white-tail deer (Odocoileus virginianus), black bear (Ursus americanus), wolf (Canis lupis), and coyote (C. latrans).

In 1985, the preliminary survey of moose included only 20 individuals from which both kidney and liver were analyzed for cadmium. These results are presented in Appendix A and complete details are found in the report, "A Preliminary Survey of Cadmium in Moose Kidney and Liver Tissue in Manitoba" (McEachern 1986). In 1986, a public awareness program was initiated with various incentive programs. Advertising through posters, pamphlets and news releases were solicited toward cooperative support from hunters.

Manitoba hunters responded well and as a result a greater number of samples were submitted with increased representation of provincial game hunting areas or GHA's (Figure 1). In total, 160 moose samples and 55 samples of elk were voluntarily provided from the 1986/87 hunting season. In addition, samples of bear, wolf, coyote and deer were collected.

Analytical results are limited to moose and elk in this report. Analyses of other species are as yet incomplete and may be presented in a future report.

2. STUDY METHODS

In cooperation with the regional conservation officers of the Manitoba Department of Natural Resources, hunters were requested to submit one kidney, a section of liver and the lower jaw of moose or elk. Designated sample drop-off sites were available in each GHA.

The animal's sex and location of kill were included with each sample submitted. Lower jaws were forwarded to the Wildlife Branch of the Department of Natural Resources in Winnipeg where incisor bars were extracted and teeth aged. A selection of 100 moose samples were made to cover a range of ages in each sex within as many GHAs as possible. Together with the 55 elk samples, these were processed for chemical analysis.

Kidney and liver organs of selected animals were forwarded to the Department of Environment and Workplace Safety and Health. A 5 gram subsample from each organ was submitted to the W. M. Ward Technical Services Laboratory in Winnipeg for cadmium analysis by atomic absorption spectrophotometry.

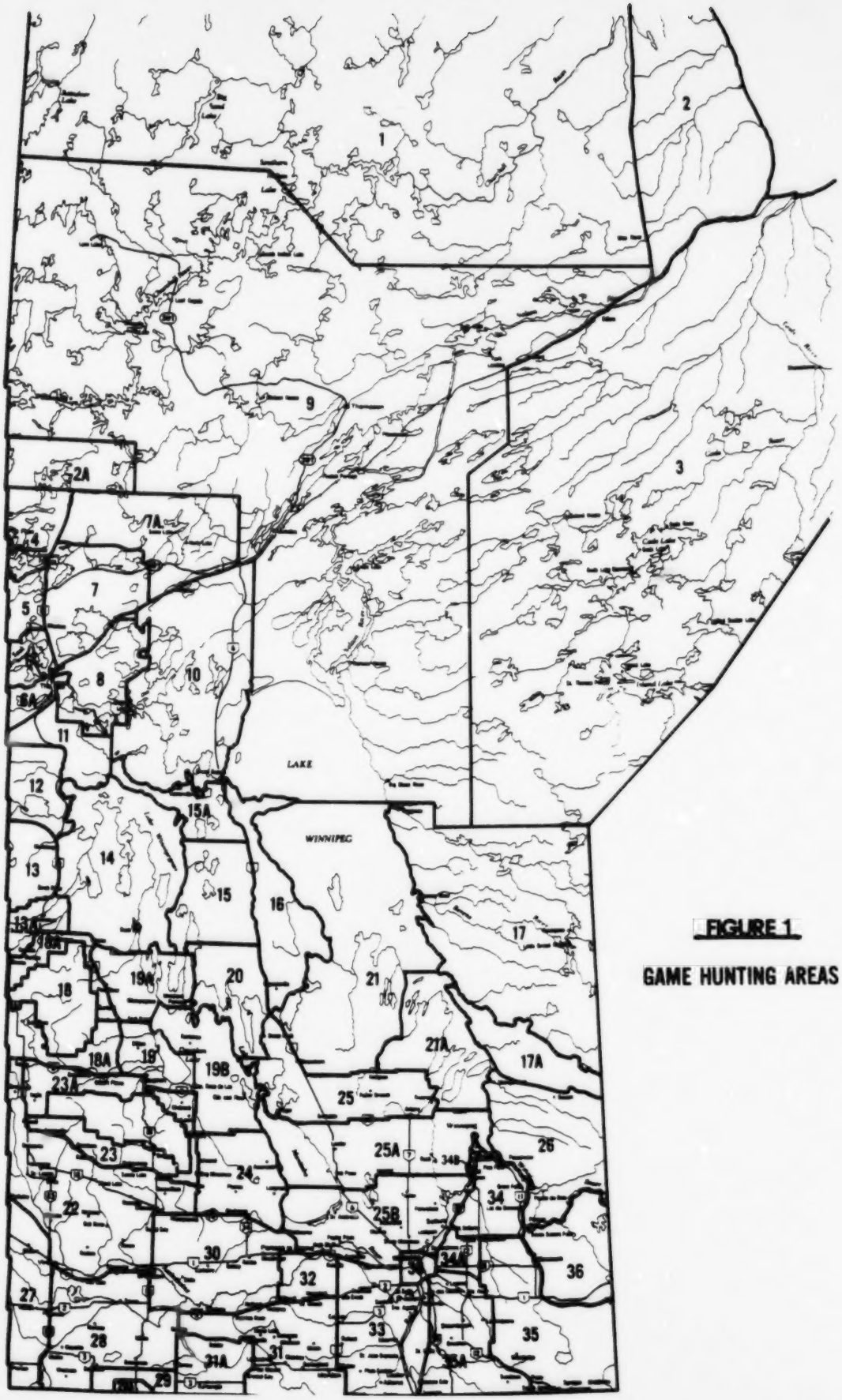

FIGURE 1

GAME HUNTING AREAS

3. RESULTS AND DISCUSSION

The cadmium concentrations found in the 1985 preliminary survey of moose kidney and liver presented in Appendix A. A summary of the 1986 cadmium values found in kidney and liver of moose and elk are presented in Appendix B and C respectively. The 1985 data were not included in the evaluation of cadmium concentrations reported herein.

3.1 KIDNEY ANALYSIS - MOOSE

In Figure 2, the relationship between cadmium concentration in kidney versus age of moose is presented. A positive correlation ($r^2 = 0.47$) was found between increasing cadmium concentration and the age of animals. This was anticipated due to the bioaccumulation characteristic of cadmium in animal systems. A listing of all cadmium concentrations and ages is found in Appendix B. A relationship between sex and cadmium accumulation does not appear to be present.

The highest cadmium value found was 42.7 mg/kg which was from an animal 10.5 years old taken in Game Hunting Area 18, in the Duck Mountain Provincial Park. The lowest cadmium level was 0.03 mg/kg from GHA 21A in the Interlake. There were 6 animals that had cadmium levels of 30 to 42.7 mg/kg in kidney. These animals had an average age of 11 years ranging from 8.5 to 15.5 years. There were 10 animals with cadmium values between 20 to 30 mg/kg and these animals had an average age of 8.8 years ranging from 4.5 to 12.5 years.

A scattergram of cadmium concentrations by game hunting area is shown in Figure 3. This gives an indication of which locations in the

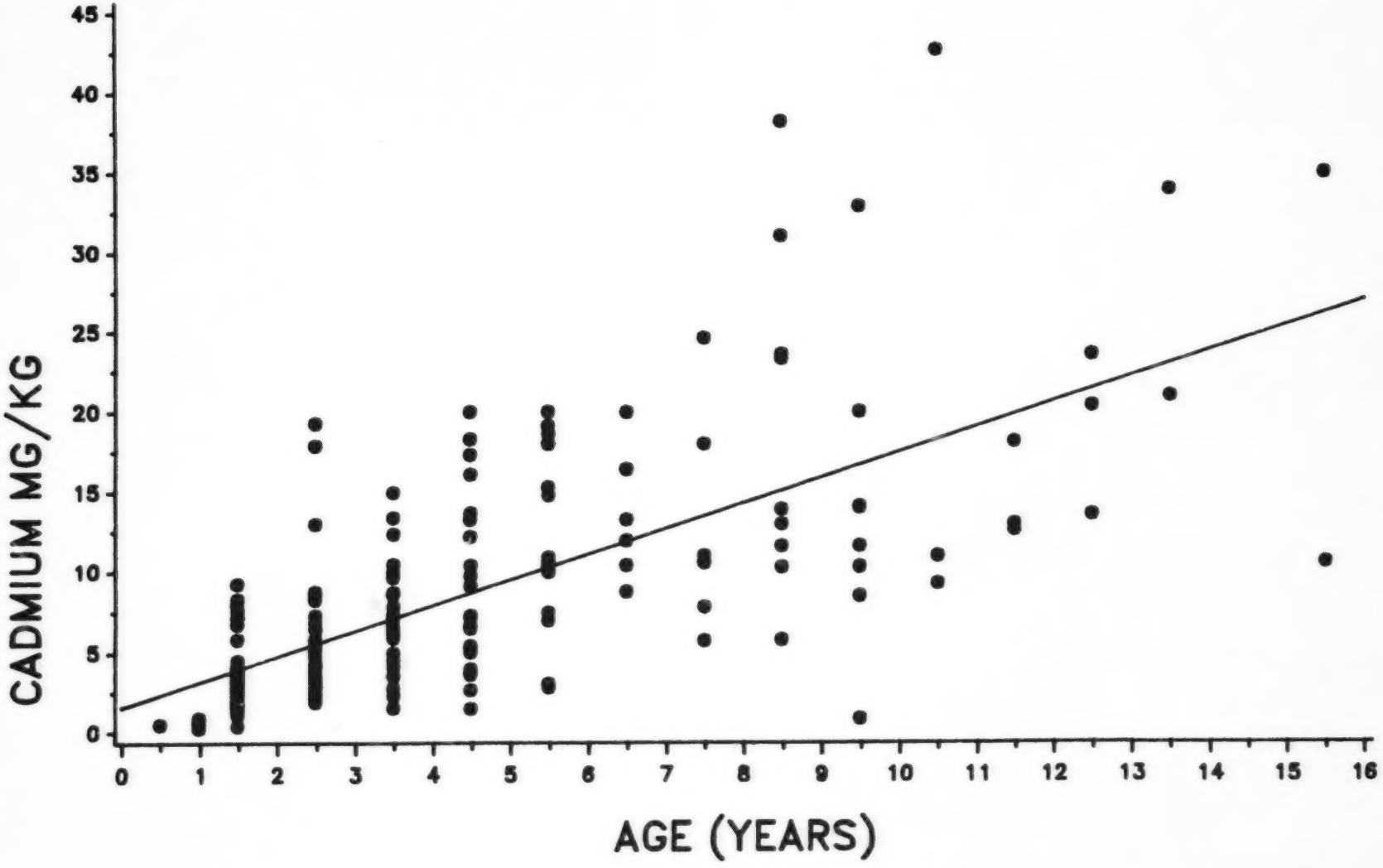

FIG.2: CADMIUM IN MOOSE KIDNEY VS AGE
MANITOBA, 1986

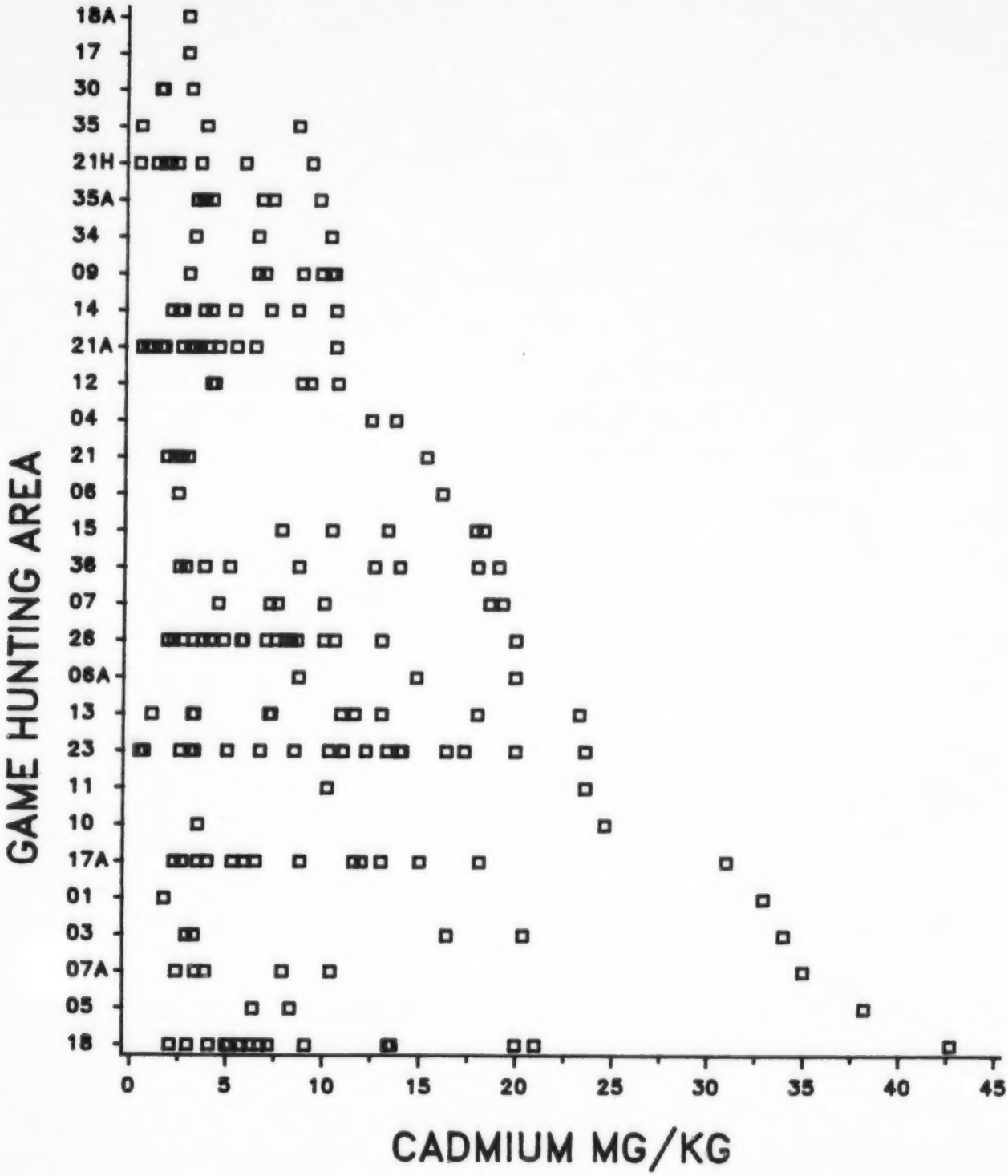

FIG.3: CADMIUM IN MOOSE KIDNEY COLLECTED FROM EACH GAME HUNTING AREA IN MANITOBA, 1986

province have elevated levels of cadmium as well as an indication of the range of cadmium values found in each GHA. The number of animals in each GHA with concentration of cadmium in kidney above 20 mg/kg was variable, however, the largest number were generally from the western region of the province. This includes the Snow Lake area south to Riding Mountain Park (Hunting Areas 23 and 23A, outside the Boundaries of the Park.). However, moose with cadmium levels above 20 mg/kg were also found in the northern, northeastern and in southeastern areas of the province.

It should be noted that the value of 20 mg/kg cadmium in kidney does not have a particular significance as a target level. For the purposes of this survey, it is used as a comparative figure based on concentrations reported in Ontario. In 1985, concentrations of cadmium in moose liver ranged between 22 and 99 mg/kg in Ontario.

A target value for consumption of cadmium in animal tissues has been recommended by the World Health Organization. The WHO recommends that human consumption should not exceed 0.5 mg/kg Cd per week (Environment Canada 1972). Based on this value, a kidney with more than 2 mg/kg should not be consumed. As a result, the Manitoba Department of Health has issued a recommendation to hunters that kidneys of Manitoba moose should not be consumed.

3.2 LIVER ANALYSIS - MOOSE

Analytical results for cadmium concentrations in moose liver versus the age of animals are found in Figure 4. As with the cadmium in moose kidney data, there is a linear relationship between concentration and age. The correlation (r^2 = 0.3)between increasing cadmium concentration in liver with increased age is clearly illustrated. Analytical results do not appear to relate cadmium accumulation with sex of the animal.

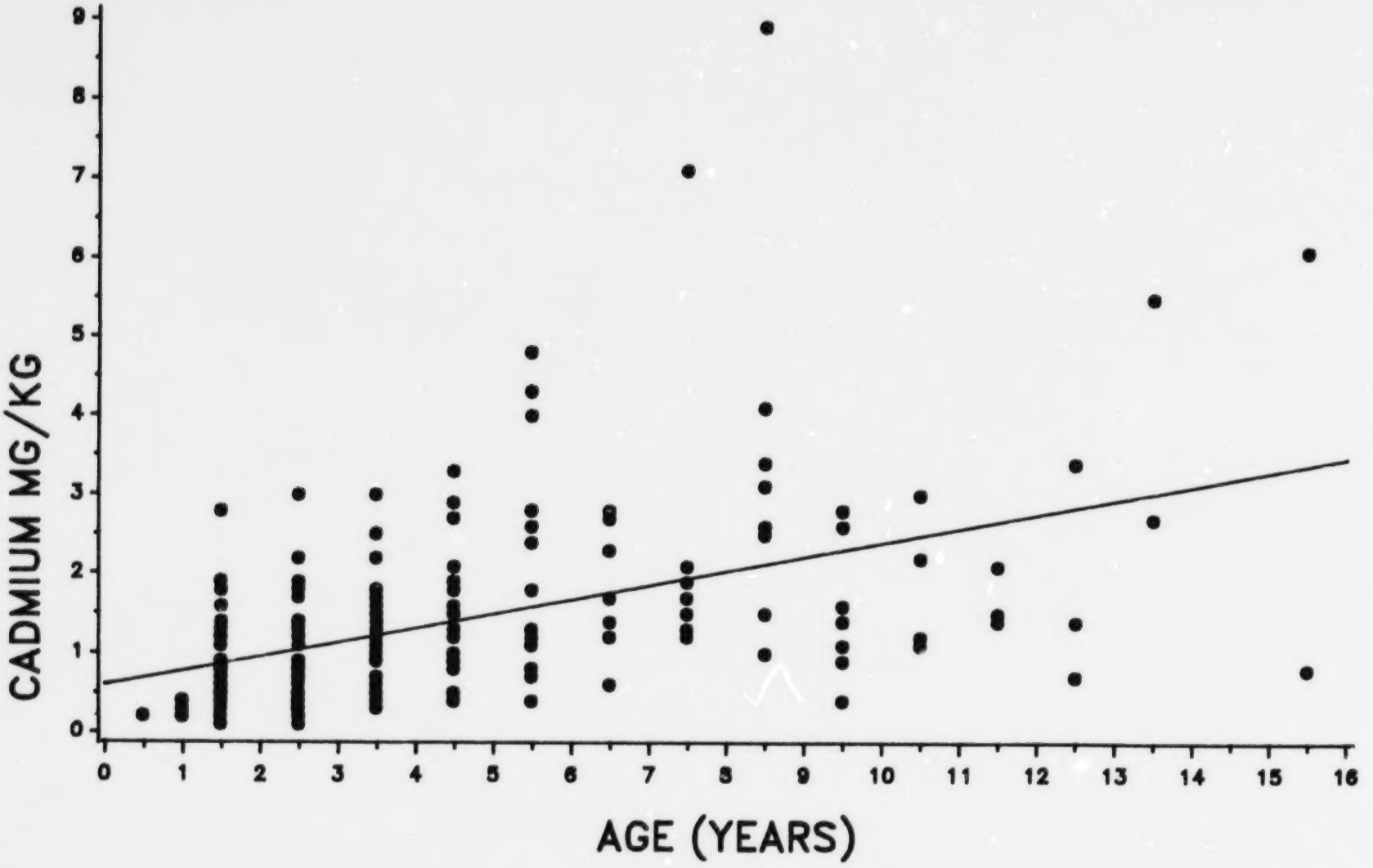

FIG.4: CADMIUM IN MOOSE LIVER VS. AGE
MANITOBA, 1986.

The highest value of cadmium was 8.9 mg/kg from an animal 8.5 years old (Appendix B). This animal was killed in GHA 5, south of Athapapuskow Lake. The lowest value of cadmium was 0.1 mg/kg from a 1.5 year old animal in GHA 12, west of Lake Winnipegosis.

A graphical display of cadmium in liver values found in the various game hunting areas is provided in Figure 5. Game hunting areas have been arranged according to maximum cadmium concentrations ranked from highest levels to lowest. The World Health Organization's recommended level for consumption is 2.0 mg/kg. Cadmium concentrations in moose liver below 2.0 mg/kg were found in only 9 game hunting areas. There were 10 GHA where values of cadmium were found between 2.0 and 3.0 mg/kg and an additional 10 GHA's where Cd values ranged from 3.0 to 9.0 mg/kg.

Moose taken from the west side of the province generally had higher levels of cadmium. This is similar to the distribution pattern for cadmium in kidney, and includes game hunting areas from Snow Lake to Riding Mountain Park. However, other areas of the province also had one or more moose with cadmium concentrations above 2.0 mg/kg. These included GHA's 17A and 26 on the east side of Lake Winnipeg, as well as GHA 3 in the northeastern part of the province and GHA 1 to the far north.

The age of animals with cadmium levels between 3.0 and 8.9 mg/kg in liver ranged from 4.5 to 8.5 years. For those animals with cadmium concentrations from 2.0 to 3.0 mg/kg, the age varied from 1.5 to 11.5 years (Figure 5). In general, there were a limited number of animals in any game hunting area that exceeded the WHO recommended level of 2.0 mg/kg.

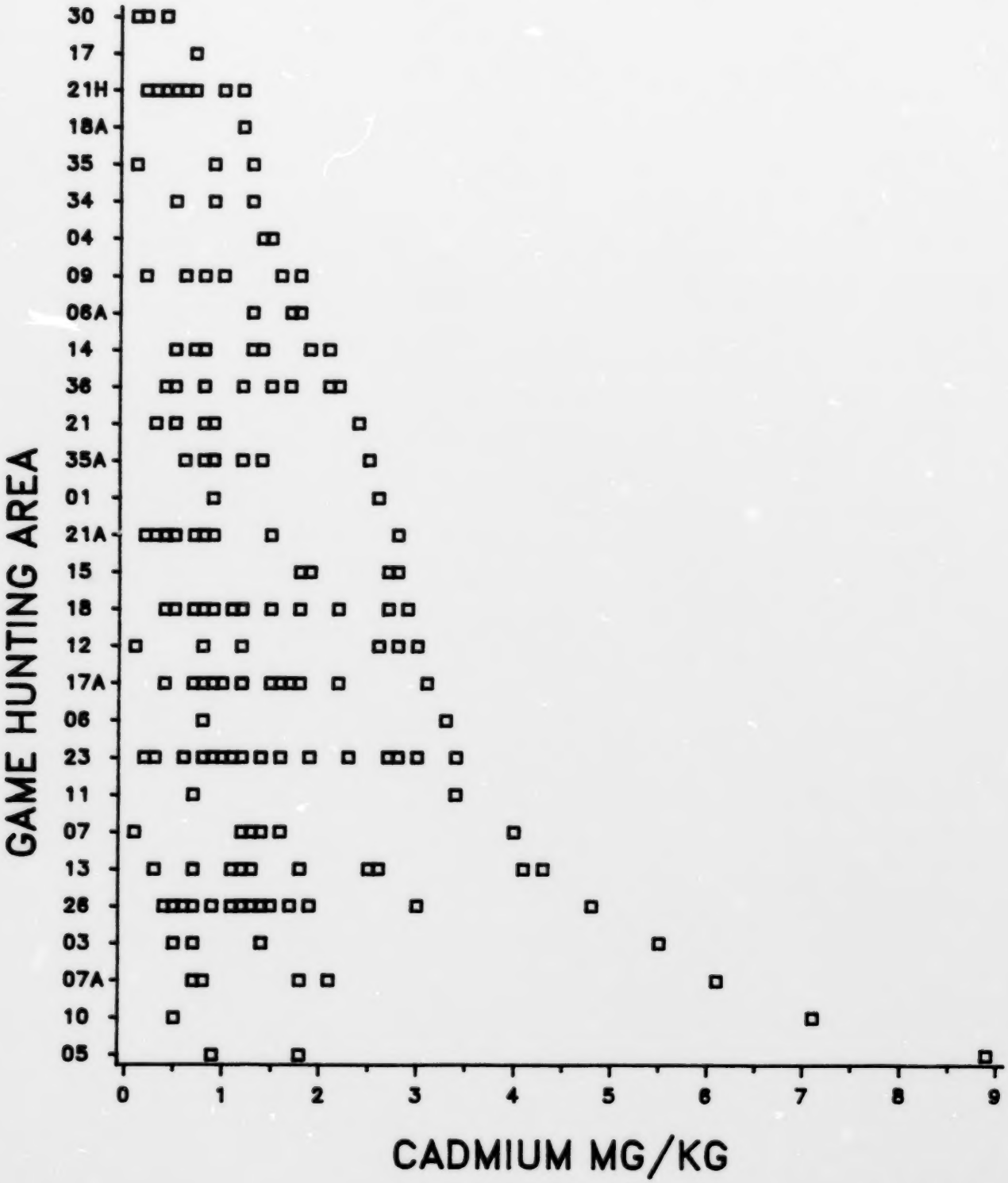

FIG.5: CADMIUM IN MOOSE LIVER COLLECTED FROM EACH GAME HUNTING AREA IN MANITOBA,1986

The Manitoba Department of Health recommends that moose liver consumption be limited based on the available information to date. The recommendation is that no more than one meal of moose liver should be eaten per week. However, they did note that the safest choice was not to eat any moose liver or kidney (Appendix D).

3.3 KIDNEY ANALYSIS - ELK

A listing of cadmium concentrations in the kidney of elk is found in Appendix C. Cadmium values ranged from 0.8 to 39.2 mg/kg in kidney. Because of the limited distribution of elk in the Province, all elk samples were taken from only 4 GHAs: 13, 18, 23, 23A. The largest number of elk came from GHAs 23 and 23A which are located adjacent to Riding Mountain Park. The sex of the animals did not appear to be the cause of the variability in cadmium concentrations.

A total of 55 elk samples were analyzed. One animal from each of GHAs 13 and 18, five from GHA 23A north of Riding Mountain Park and forty-eight animals from GHA 23 south of Riding Mountain were sampled. Of the latter, 3 samples had Cd in kidney above 20 mg/kg; these three animals had ages of 12.5, 16.5 and 18.5 years. In the range of 10 to 20 mg/kg, there were 14 animals of which 12 were from GHA 23. The age of these animals ranged from 0.5 to 18.5 years (Appendix C).

The relationship between cadmium concentration in elk kidney and age of animal is shown in Figure 6. Similar to the moose, a positive correlation exists between increasing levels of cadmium and increasing age of the animal. However, there are wide variances such as in GHA 23 where the

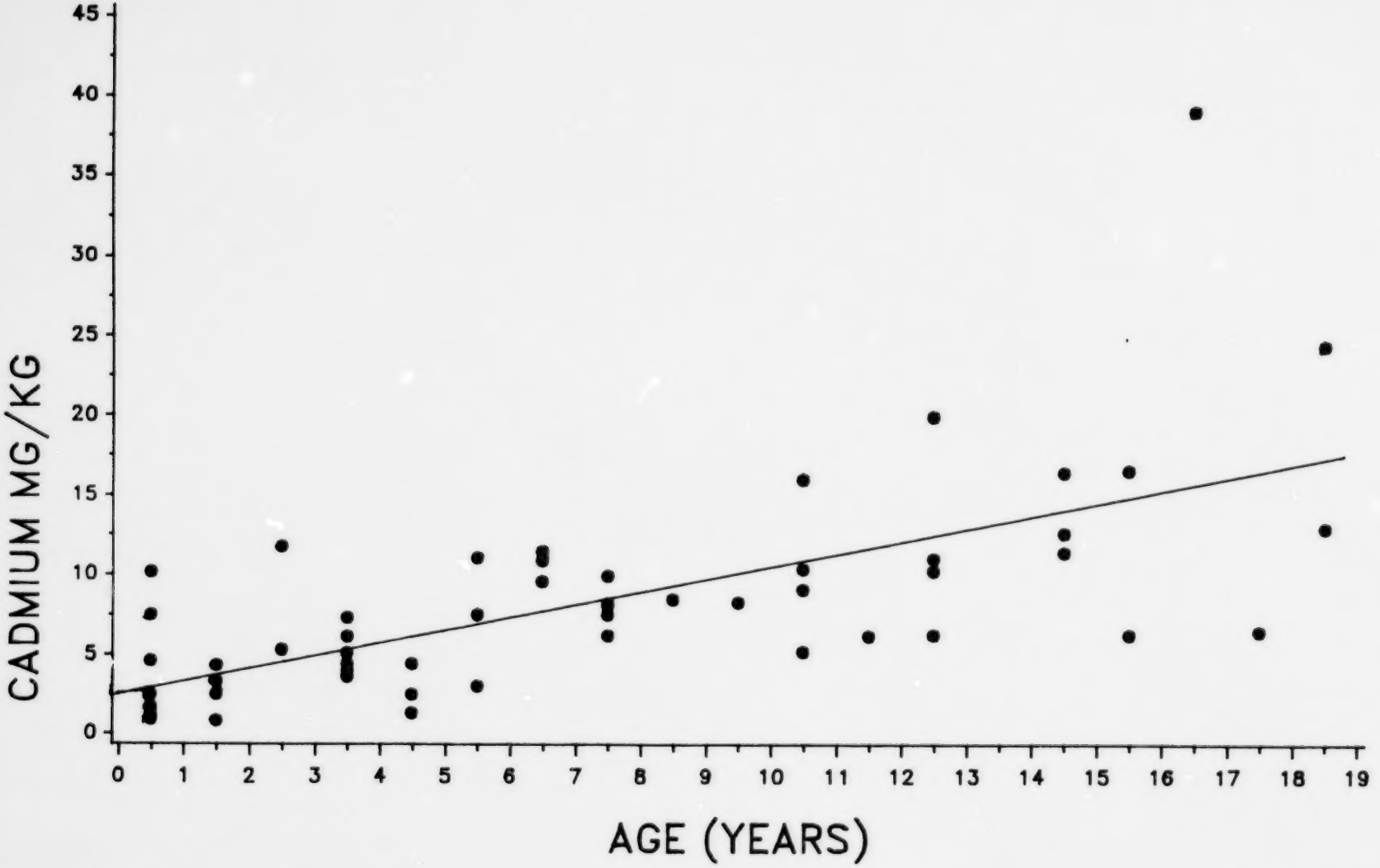

FIG.6: CADMIUM IN ELK KIDNEY VS. AGE MANITOBA, 1986.

animal with the highest cadmium value of 39.5 mg/kg is 16.5 years old. In the same area an animal 17.5 years old was found to have a cadmium value of only 6.5 mg/kg (Appendix A).

3.4 LIVER ANALYSIS - ELK

The cadmium concentrations found in elk liver are listed in Appendix C. Cadmium concentrations are lower than those found in kidney and range from 0.1 to 1.3 mg/kg. A relationship between sex and cadmium concentration is not evident.

The concentration of cadmium is positively correlated with age of the animal (Figure 7). There were only 2 values which exceeded 1.0 mg/kg. The highest value 1.3 mg/kg was from the same animal which had the highest cadmium level in kidney. The second highest value was 1.1 mg/kg and was from the animal that had the second highest cadmium level in kidney. These animals were both from GHA 23 at the south side of Riding Mountain National Park and their ages were 16.5 and 18.5 years respectively.

In general, cadmium in liver values are uniformly low for the 55 animals evaluated. Based on the analytical results available, there are no values which exceed the World Health Organization's recommended guideline for consumption of 2.0 mg/kg.

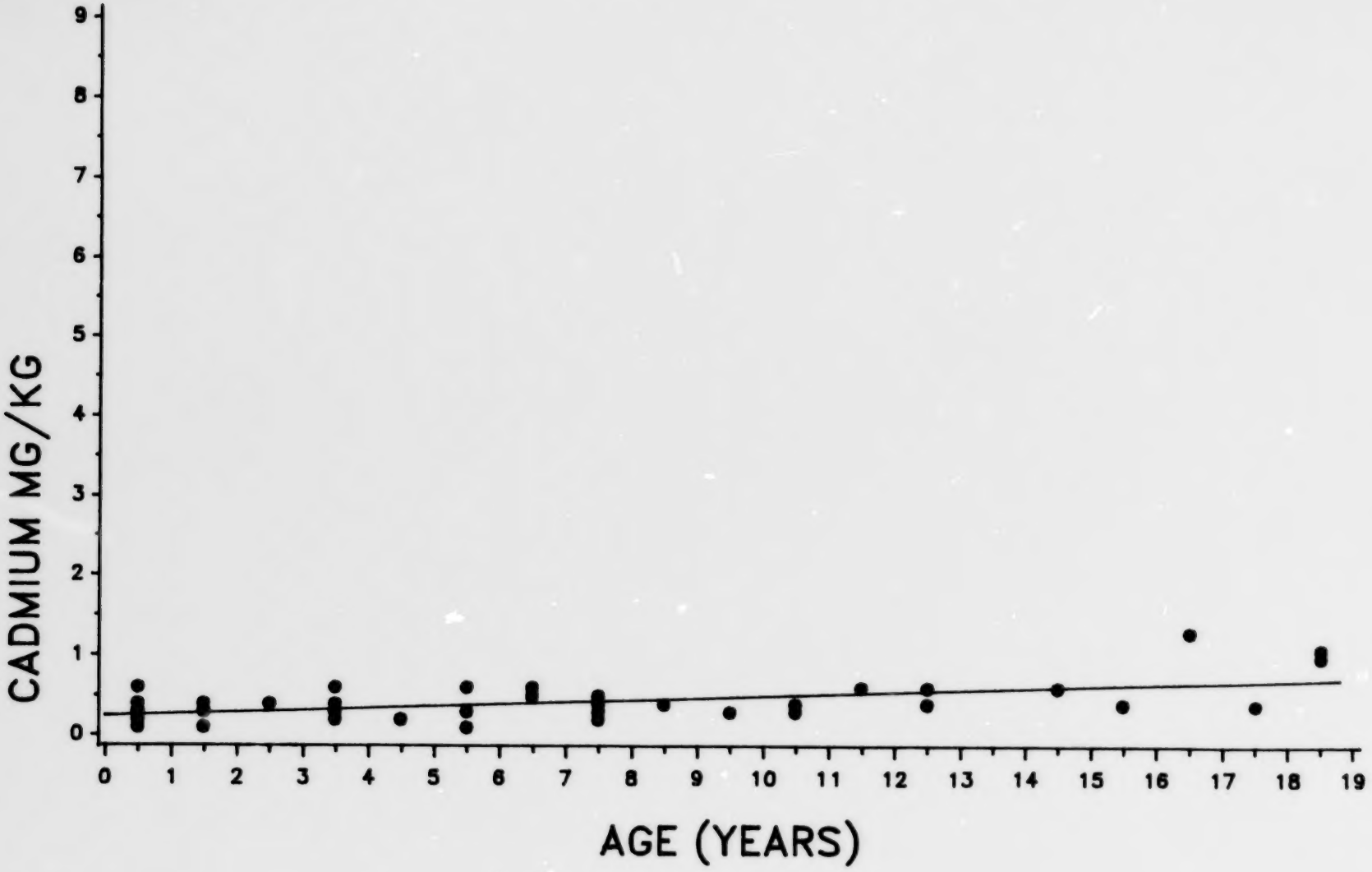

FIG.7: CADMIUM IN ELK LIVER VS. AGE
MANITOBA, 1986.

4.0 CONCLUSIONS

(i) Cadmium concentrations found in the kidney and liver of moose and elk do not appear to be related to sex of the animal.

(ii) Cadmium concentrations found in the kidney and liver of moose and elk are positively correlated with age of the animal; cadmium accumulates as the animal gets older.

(iii) Cadmium concentrations are higher in the kidney of both moose and elk.

(iv) Cadmium concentrations appear to be highest in the western region of the province, particularly between Snow Lake and Riding Mountain Park.

(v) Cadmium concentrations were elevated in isolated animals from the Bissett area, and the northern game hunting areas.

(vi) Cadmium concentrations in elk were found to be highest in the Riding Mountain area, but were considerably lower than those in moose.

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APPENDICES

APPENDIX A: CADMIUM LEVELS IN MOOSE KIDNEY AND LIVER, 1985

Location GHA	Sex	Age (yr)	Cd in Kidney (mg/kg)	Cd in Liver (mg/kg)
7	M	2.5	2.5	2.1
9	M	9.5	13.2	2.4
10	M	-	8.4	5.2
12	M	2.5	0.9	0.7
17A	M	11.5	19.0	2.9
21	F	1.5	0.9	0.3
21	M	4.5	6.7	0.5
21	F	5.5	8.8	1.6
23	F	5.5	7.3	1.6
26	M	3.5	12.0	3.7
26	M	3.5	4.5	-
30	M	4.5	4.2	1.5
35	M	2.5	2.1	0.8
35	M	3.5	3.3	1.0
35	M	5.5	13.0	2.5
35A	M	6.5	17.8	5.7
36	F	1.5	3.9	1.1
36	M	1.5	2.5	-
36	F	5.5	12.0	0.9
36	M	6.5	10.2	4.9

APPENDIX B TABLE 1: CADMIUM IN MOOSE KIDNEY AND LIVER, 1986

OBS	GAME HUNTING AREA	SEX	AGE (YEARS)	CADMIUM IN KIDNEY (MG/KG)	CADMIUM IN LIVER (MG/KG)
1	01	M	1.5	1.8	0.9
2	01	M	9.5	32.9	2.6
3	03	M	1.5	3.3	0.5
4	03	M	2.5	2.9	0.7
5	03	M	6.5	16.4	1.4
6	03	M	12.5	20.4	1.4
7	03	M	13.5	34.0	5.5
8	04	M	3.5	12.4	1.4
9	04	M	4.5	13.7	1.5
10	05	M	1.5	8.3	1.8
11	05	M	2.5	6.4	0.9
12	05	M	8.5	38.2	8.9
13	06	M	1.5	2.4	0.8
14	06	M	4.5	16.1	3.3
15	06A	M	3.5	8.7	1.3
16	06A	M	5.5	14.8	1.8
17	06A	M	6.5	20.0	1.7
18	07	M	1.5	7.6	1.4
19	07	M	1.5	7.2	1.6
20	07	M	1.5	4.5	1.3
21	07	M	2.5	19.3	0.1
22	07	M	5.5	10.0	1.2
23	07	M	5.5	18.6	4.0
24	07A	M	1.5	3.9	0.7
25	07A	M	1.5	3.4	0.7
26	07A	M	1.5	2.4	0.8
27	07A	M	3.5	7.9	1.8
28	07A	M	4.5	10.4	2.1
29	07A	M	15.5	35.0	6.1
30	09	M	1.5	2.9	0.6
31	09	M	2.5	6.9	0.2
32	09	M	2.5	6.5	0.8
33	09	M	3.5	10.5	1.6
34	09	M	4.5	9.8	1.8
35	09	M	6.5	8.8	0.6
36	09	M	8.5	10.3	1.0
37	10	M	1.5	3.5	0.5
38	10	M	7.5	24.6	7.1
39	11	M	5.5	10.2	0.7
40	11	M	8.5	23.6	3.4
41	12	M	1.5	4.1	0.1
42	12	M	1.5	9.3	2.8
43	12	M	2.5	4.3	0.8
44	12	M	2.5	4.2	1.2
45	12	M	2.5	8.8	3.0
46	12	M	5.5	10.7	2.6
47	13	M	1.5	1.1	0.3
48	13	M	2.5	3.2	0.7
49	13	M	2.5	3.3	0.7
50	13	M	2.5	7.3	1.1
51	13	M	4.5	7.2	1.3
52	13	M	4.5	7.3	1.2
53	13	M	5.5	16.0	4.3

APPENDIX B TABLE 1: CADMIUM IN MOOSE KIDNEY AND LIVER, 1986

OBS	GAME HUNTING AREA	SEX	AGE (YEARS)	CADMIUM IN KIDNEY (MG/KG)	CADMIUM IN LIVER (MG/KG)
54	13	M	5.5	10.9	1.8
55	13	M	8.5	11.6	2.6
56	13	M	8.5	23.3	4.1
57	13	M	8.5	13.0	2.5
58	14	M	1.5	4.1	0.8
59	14	M	1.5	2.4	0.7
60	14	M	1.5	3.7	0.5
61	14	M	1.5	2.6	0.8
62	14	M	1.5	2.0	0.5
63	14	M	1.5	7.2	1.3
64	14	M	2.5	8.6	1.9
65	14	M	2.5	5.3	1.4
66	14	M	7.5	10.6	2.1
67	15	M	2.5	17.9	1.9
68	15	M	4.5	18.3	1.8
69	15	M	6.5	10.4	2.7
70	15	M	6.5	13.3	2.8
71	15	M	7.5	7.8	1.9
72	17	M	5.5	2.8	0.7
73	17A	M	1.5	4.0	1.2
74	17A	M	1.5	2.7	0.7
75	17A	M	1.5	3.5	0.8
76	17A	M	2.5	8.8	1.8
77	17A	M	2.5	13.0	2.2
78	17A	M	2.5	5.3	1.2
79	17A	M	3.5	5.9	1.0
80	17A	M	3.5	15.0	1.7
81	17A	M	3.5	2.3	0.4
82	17A	M	4.5	6.5	0.9
83	17A	M	6.5	12.0	1.2
84	17A	M	8.5	31.0	3.1
85	17A	M	9.5	11.6	1.(
86	17A	M	11.5	18.1	1.5
87	18	M	1.5	5.8	1.1
88	18	M	1.5	3.0	1.2
89	18	M	1.5	6.8	1.2
90	18	M	2.5	2.1	0.8
91	18	M	3.5	7.2	0.7
92	18	M	3.5	4.1	0.4
93	18	M	3.5	5.0	1.1
94	18	M	3.5	6.2	0.9
95	18	M	3.5	13.4	1.8
96	18	M	4.5	9.1	1.5
97	18	M	4.5	20.0	2.9
98	18	M	4.5	5.2	0.5
99	18	M	10.5	42.7	2.2
100	18	M	12.5	13.6	0.7
101	18	M	13.5	21.0	2.7
102	18A	M	1.5	2.8	1.2
103	21	M	1.5	1.8	0.9
104	21	M	1.5	2.9	0.5
105	21	M	2.5	2.5	0.5
106	21	M	2.5	2.2	0.3

APPENDIX B TABLE 1: CADMIUM IN MOOSE KIDNEY AND LIVER, 1986

OBS	GAME HUNTING AREA	SEX	AGE (YEARS)	CADMIUM IN KIDNEY (MG/KG)	CADMIUM IN LIVER (MG/KG)
107	21	M	2.5	2.6	0.8
108	21	M	5.5	15.3	2.4
109	21A	F	2.5	3.2	0.8
110	21A	F	3.5	4.5	0.5
111	21A	F	3.5	3.5	0.7
112	21A	F	4.5	5.4	0.9
113	21A	F	4.5	3.9	0.5
114	21A	F	15.5	10.6	0.8
115	21A	M	1.0	0.9	0.4
116	21A	M	1.0	0.5	0.2
117	21A	M	1.5	1.7	0.4
118	21A	M	3.5	6.4	1.5
119	21A	M	3.5	3.5	0.5
120	21A	M	3.5	1.5	0.3
121	21A	M	4.5	2.6	0.4
122	21A	M	5.5	3.0	2.8
123	21A	M	9.5	0.8	0.4
124	21H	F	1.5	2.3	0.5
125	21H	F	2.5	1.9	0.4
126	21H	M	1.0	0.3	0.2
127	21H	M	1.5	1.7	0.4
128	21H	M	1.5	1.6	0.6
129	21H	M	1.5	1.2	0.3
130	21H	M	2.5	3.5	0.7
131	21H	M	8.5	5.8	1.0
132	21H	M	10.5	9.3	1.2
133	23	F	1.5	3.3	0.8
134	23	F	1.5	2.6	0.6
135	23	F	3.5	5.0	0.6
136	23	F	4.5	6.7	0.8
137	23	F	4.5	13.3	1.9
138	23	F	6.5	16.4	2.3
139	23	F	7.5	11.0	1.2
140	23	F	9.5	14.1	0.9
141	23	F	9.5	8.5	1.4
142	23	F	9.5	10.3	1.4
143	23	F	9.5	14.0	1.1
144	23	F	12.5	23.6	3.4
145	23	M	0.5	0.5	0.2
146	23	M	1.0	0.7	0.3
147	23	M	1.5	3.1	0.6
148	23	M	4.5	17.3	1.6
149	23	M	4.5	5.0	1.0
150	23	M	4.5	12.2	2.7
151	23	M	9.5	20.0	2.8
152	23	M	10.5	11.0	3.0
153	23	M	10.5	11.0	1.1
154	26	M	1.5	3.7	0.4
155	26	M	1.5	2.2	0.5
156	26	M	1.5	3.2	0.7
157	26	M	1.5	1.9	0.5
158	26	M	1.5	4.1	1.2
159	26	M	1.5	8.0	1.9

APPENDIX B TABLE 1: CADMIUM IN MOOSE KIDNEY AND LIVER, 1986

OBS	GAME HUNTING AREA	SEX	AGE (YEARS)	CADMIUM IN KIDNEY (MG/KG)	CADMIUM IN LIVER (MG/KG)
160	26	M	2.5	4.1	0.9
161	26	M	2.5	5.8	1.7
162	26	M	2.5	2.7	0.6
163	26	M	2.5	4.8	1.3
164	26	M	2.5	8.3	1.4
165	26	M	3.5	10.0	3.0
166	26	M	3.5	8.6	1.2
167	26	M	4.5	3.7	0.5
168	26	M	5.5	7.0	1.1
169	26	M	5.5	7.5	1.1
170	26	M	5.5	20.0	4.8
171	26	M	7.5	5.7	1.3
172	26	M	7.5	10.6	1.5
173	26	M	11.5	13.0	1.4
174	30	M	1.5	1.4	0.2
175	30	M	1.5	1.4	0.1
176	30	M	4.5	1.5	0.4
177	30	M	5.5	3.0	0.4
178	34	M	2.5	3.2	0.5
179	34	M	4.5	6.5	0.9
180	34	M	5.5	10.3	1.3
181	35	F	1.5	0.4	0.1
182	35	M	2.5	3.8	1.3
183	35	M	3.5	8.6	0.9
184	35A	M	1.5	3.7	1.2
185	35A	M	1.5	3.3	0.8
186	35A	M	1.5	3.6	0.6
187	35A	M	2.5	4.1	1.4
188	35A	M	3.5	6.7	0.9
189	35A	M	3.5	9.7	2.5
190	35A	M	3.5	7.3	0.9
191	35A	M	4.5	3.6	0.9
192	36	F	1.5	2.5	0.4
193	36	F	1.5	3.8	0.8
194	36	F	3.5	2.8	0.5
195	36	F	8.5	13.9	1.5
196	36	M	2.5	5.1	1.2
197	36	M	3.5	8.7	2.2
198	36	M	5.5	19.1	0.8
199	36	M	7.5	18.0	1.7
200	36	M	11.5	12.6	2.1

APPENDIX C TABLE 1: CADMIUM IN ELK KIDNEY AND LIVER, 1986

OBS	GAME HUNTING AREA	SEX	AGE (YEARS)	CADMIUM IN KIDNEY (MG/KG)	CADMIUM IN LIVER (MG/KG)
1	13	M	1.5	0.8	0.1
2	18	M	10.5	10.4	0.4
3	23	F	0.5	0.9	0.2
4	23	F	0.5	1.6	0.3
5	23	F	0.5	7.5	0.3
6	23	F	0.5	1.2	0.2
7	23	F	1.5	4.3	0.3
8	23	F	1.5	2.5	0.3
9	23	F	2.5	11.8	0.4
10	23	F	3.5	3.6	0.2
11	23	F	3.5	7.3	0.4
12	23	F	3.5	4.0	0.4
13	23	F	3.5	6.1	0.6
14	23	F	4.5	4.4	0.2
15	23	F	4.5	1.3	0.2
16	23	F	4.5	2.5	0.2
17	23	F	5.5	11.1	0.6
18	23	F	6.5	11.5	0.5
19	23	F	6.5	10.9	0.5
20	23	F	6.5	9.6	0.6
21	23	F	7.5	8.1	0.4
22	23	F	7.5	6.2	0.4
23	23	F	7.5	9.9	0.5
24	23	F	8.5	8.5	0.4
25	23	F	9.5	8.3	0.3
26	23	F	10.5	9.1	0.3
27	23	F	10.5	5.2	0.4
28	23	F	12.5	6.3	0.4
29	23	F	14.5	16.5	0.6
30	23	F	16.5	39.2	1.3
31	23	F	17.5	6.5	0.4
32	23	F	18.5	13.0	1.0
33	23	F	18.5	24.5	1.1
34	23	M	0.5	0.9	0.1
35	23	M	0.5	2.5	0.2
36	23	M	0.5	10.2	0.6
37	23	M	0.5	4.6	0.4
38	23	M	0.5	1.7	0.3
39	23	M	1.5	3.3	0.4
40	23	M	2.5	5.3	0.4
41	23	M	3.5	4.4	0.3
42	23	M	7.5	8.2	0.3
43	23	M	7.5	7.5	0.2
44	23	M	10.5	16.0	0.4
45	23	M	11.5	6.2	0.6
46	23	M	12.5	20.0	0.6
47	23	M	12.5	20.3	0.4
48	23	M	12.5	21.1	0.6
49	23	M	14.5	21.5	0.6
50	23	M	14.5	22.7	0.6
51	23A	F	3.5	5.1	0.3
52	23A	F	5.5	3.0	0.3
53	23A	F	5.5	7.5	0.1
54	23A	F	15.5	16.7	0.4
55	23A	F	15.5	6.3	0.4

APPENDIX D: RECOMMENDATION ON MOOSE KIDNEY AND LIVER CONSUMPTION IN MANITOBA, 1987

Manitoba

Health Environmental Health 831 Portage Avenue
Winnipeg, Manitoba, CANADA
R3G 0N6

CADMIUM IN MOOSE

What is Cadmium?

Cadmium is a metal that is in some industrial products such as batteries, solder and fertilizer. It may also be found in soil and in ashes from forest fires.

If increased amounts of cadmium build up in a person's body it can lead to health problems including kidney failure.

Cadmium in Moose Organ Meat

Studies have shown that cadmium can be found in the organ meat of moose. The cadmium is consumed by the moose when it eats plants that have grown in soil containing cadmium. Moose do not easily excrete cadmium. Instead, most is stored in the kidneys and liver. The older the moose, the higher the level of cadmium.

What Should Not be Eaten?

Based on test results from moose in this province, Manitoba Health recommends that:

- moose kidney should not be eaten.
- moose liver has lower levels of cadmium. Therefore, no more than one meal of moose liver a week should be eaten.

The safest choice is not to eat any moose liver or kidney.

For more information please contact:

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Manitoba Natural Resources
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For further information on personal health, please contact:

Dr. N.S. Rihal, Manitoba Health: Phone: 945-6727

For further information on the consumption of liver, please contact:

Mr. Jim Sisler, Manitoba Health: Phone: 945-7066